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by Fredrik V. Thorsteinson and Theodore R. Merrell, Jr.

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FREDRIK V. THORSTEINSON and THEODORE R. MERRELL, JR.

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CONTENTS

	Page
Introduction	1
Methods	2
Results	7
Full-twist versus half-twist knots for tags	7
Sockeye salmon	7
Chum salmon	10
Pink salmon	10
Coho and king salmon	10
Summary	14
Literature cited	14

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ABSTRACT

Sockeye, chum, and pink salmon were captured by purse seine and tagged from mid-June to mid-July 1961 south of Unimak Island and off the southwestern shore of the Alaska Peninsula. A westerly migration followed by a northeasterly migration was demonstrated. Tagged sockeye salmon were recovered mainly in the fisheries of the Kvichak, Naknek, and Egegik Rivers of Bristol Bay; tagged chum salmon were caught along the Bering Sea coast from Bristol Bay to the Yukon River; and most tagged pink salmon were recovered relatively close to the tagging area.

INTRODUCTION

A salmon fishery has operated annually along the south shore of Unimak Island between Cape Pankof and Cape Lutke since the early 1930's. Fishing is concentrated in the vicinity of Cape Lutke and lasts a comparatively short time--usually between June 10 and 30. Fishing is done exclusively by purse seines and drift gill nets. All species of northeast Pacific salmon are taken, but sockeye (Oncorhynchus nerka), chum (O. keta), and pink (O. gorbuscha) are most abundant. From 1952 through 1961, annual catches ranged from 200,000 to 900,000 fish, with an average of 390,000. The average annual catch of each principal species was: sockeye, 175,000; chum, 150,000; and pink, 65,000. The 1961 catches in this area were:[1] sockeye, 199,105; chum, 157,006; and pink, 18,598.

Even-year catches of pink salmon tend to be larger than odd-year catches. No cycles appear in the sockeye and chum salmon catches. The catch probably does not accurately reflect the numbers of salmon in the area because stormy weather frequently affects the distribution and intensity of fishing effort. Also, fishing is limited to the shoreline within the 3-mile limit.

Salmon were tagged in 1922-23 and in 1958 off the southwestern shore of the Alaska Peninsula at sites ranging from 60 to 150 miles east of Cape Lutke (Gilbert 1959). Tagged sockeye and chum salmon from these experiments were recovered in Bristol Bay and at various points along the eastern Bering Sea coast. The recoveries indicated a westerly migration followed by a northeasterly movement into the Bering Sea. When the salmon were tagged in 1922 and 1923, there was no Cape Lutke fishery, and in 1958 the fish were tagged too late in the season to be recovered there. Only one tagged salmon was recaptured in the Cape Lutke fishery in 1958--a pink salmon tagged at Unga Island on June 23 and recaptured on June 28. Information, therefore, was needed to ascertain if the Cape Lutke fishery was intercepting the same stock of migrating salmon that had been tagged in early years to the east and if this was the last point at which they were taken south of the Bering Sea.

In 1961 the Bureau of Commercial Fisheries tagged salmon off the south shore of Unimak Island and the southwestern shore of the Alaska Peninsula (fig. 1) to provide answers to these questions and to supply information on the age composition and ultimate destinations of these salmon. The tagging was part of the intensified salmon research program financed by the U.S. Government to provide information on optimum escapements and prediction of North American salmon runs for the International North Pacific Salmon Fisheries Commission.

[1] Catch data from State of Alaska Department of Fish and Game.

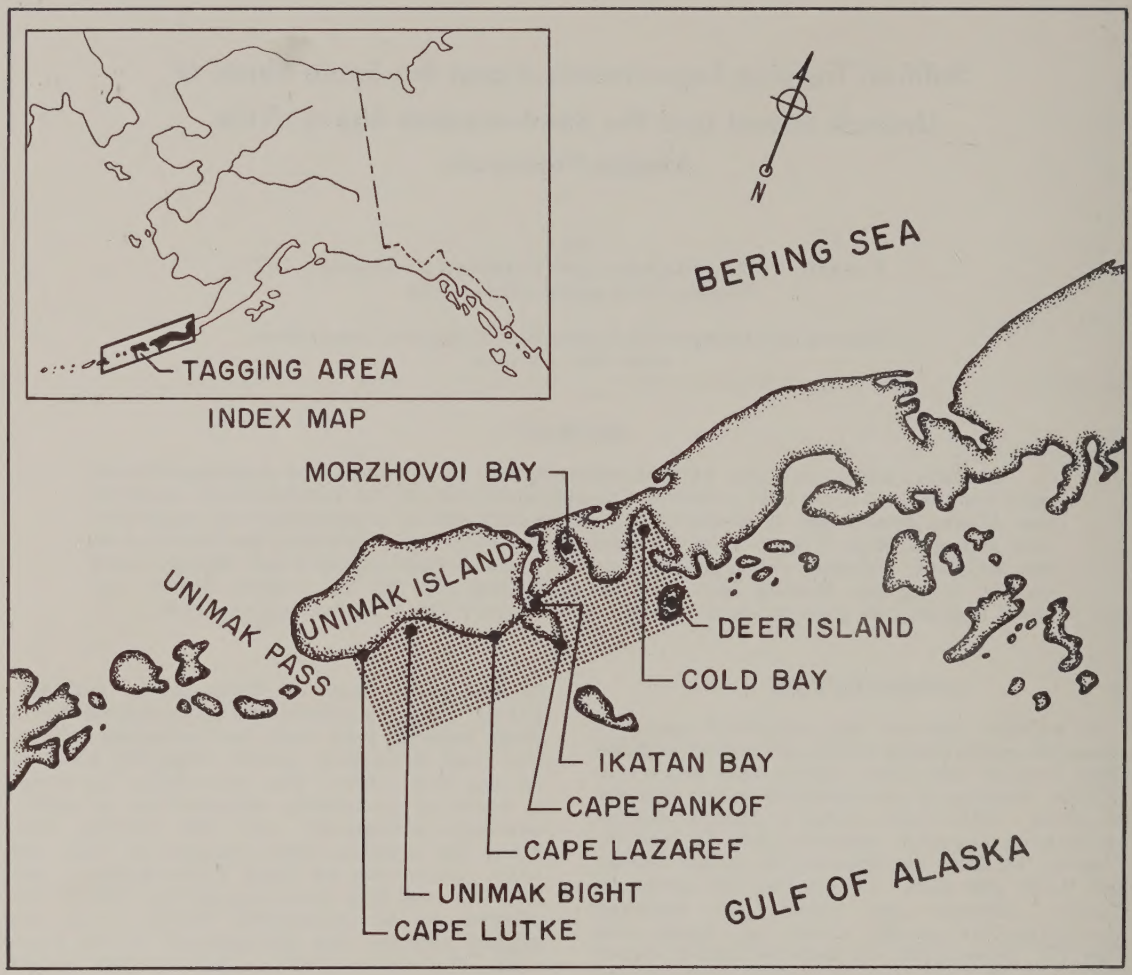


Figure 1.--Area of salmon tagging experiments, south shore of Unimak Island and southwestern shore of Alaska Peninsula, 1961.

METHODS

The California Rose, a 78-foot purse seiner was chartered to capture salmon for tagging (fig. 2). The boat was originally built as a California tuna clipper, was later used as a Puget Sound salmon seiner, and has recently been converted for winter king crab fishing around Kodiak Island. The last conversion included adding of an 8,000-gallon circulating sea-water tank that was ideal for holding captured salmon until they could be tagged.

The purse seine was originally constructed for salmon fishing on Puget Sound and was much larger than the legal maximum for commercial fishing in the Unimak tagging area. It was tarred cotton with 4-1/2-inch mesh (stretch measure); the circumference was approximately 300 fathoms, and the depth, 33 fathoms.

The general procedure in making a set is illustrated in figure 3. All sets were blind, that is, there was no visible evidence of salmon when the net was put overboard. The bunt end of the net was pulled off the stern with the seine skiff while the California Rose maintained slow speed headway during the entire set. The seine skiff gradually pulled the net around to port of the seiner, gaging its direction and distance to end on a parallel course with the seiner when the entire net had been pulled off the stern. Each boat then slowly moved ahead, and the net was towed as an open seine for time periods ranging from 30 to 55 minutes. Theoretically, this would intercept migrating fish. Nearly all

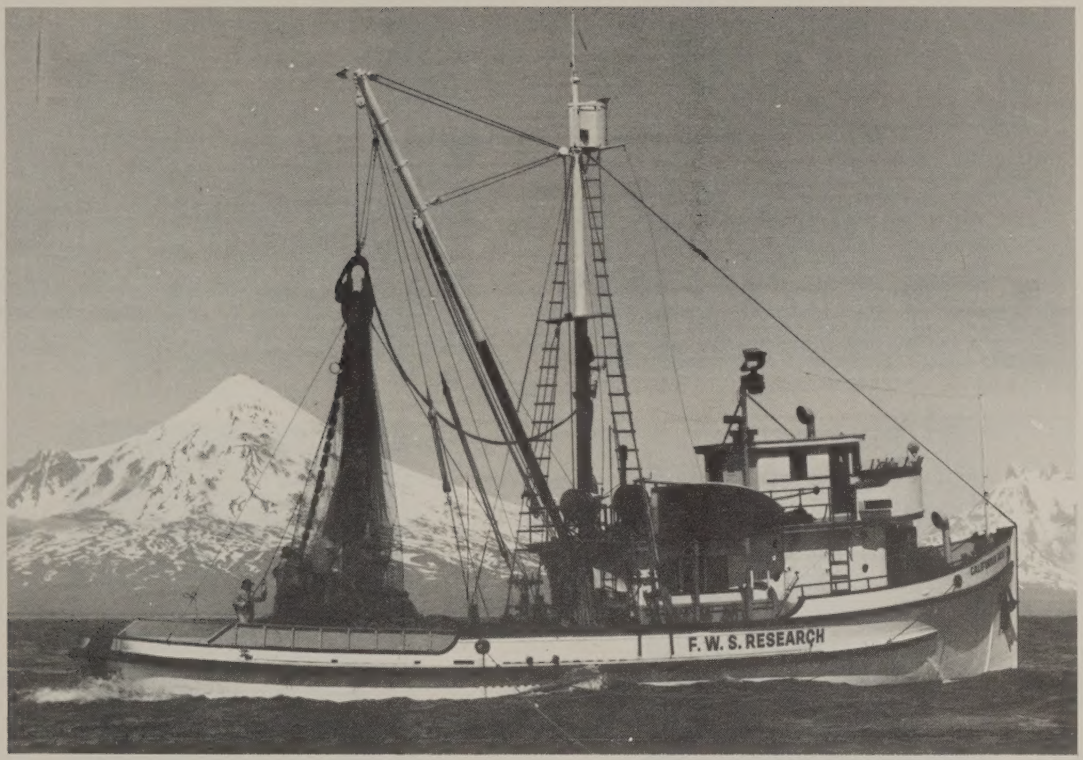


Figure 2.--California Rose, purse seiner used in salmon tagging experiments, south shore of Unimak Island and southwestern shore of Alaska Peninsula, 1961.

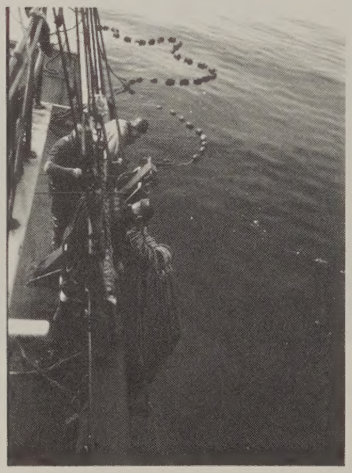
tows were with the net open to the north and east because previous tagging along the south side of the Aleutian Islands had demonstrated that salmon here usually migrate in a westerly direction (Hartt, 1962). At the end of the tow, the skiff pulled the bunt end of the net to the seiner, where the end was made fast. The purse line was then drawn tight, and the purse rings were hauled aboard, completing the encirclement of any fish within the pursed net. The lead line, made of heavy chain, was then hauled aboard, and the end of the net was put through the power block. The power block pulled the net aboard, and six men stacked the webbing on the stern as it descended from the block. During net retrieval, the seine skiff pulled the vessel broadside into the wind to prevent it from drifting over the pursed seine. Fish were gradually forced to the bunt end of the seine from which they were pocketed and dipped into the live tank with hand dip nets. Standoff poles were used from the seine skiff during the dipping, separating the vessel and skiff to prevent injury to the fish. As fish were removed, the bunt was gradually "dried up" until all fish had been transferred to the tank. For more complete descriptions of general details of purse seining, see McNeely (1961) and Hartt (1962).

Salmon were tagged with serially numbered, red Petersen cellulose acetate disk tags, 22 mm. in diameter, which were fastened with nickel pins at the origin of the dorsal fin. No anesthetic was used, and releases were made as quickly as possible near the location of capture. Usually, two crews tagged fish simultaneously on opposite sides of the vessel, dipping them from the live tank amidships; when few fish were captured, only one crew tagged.

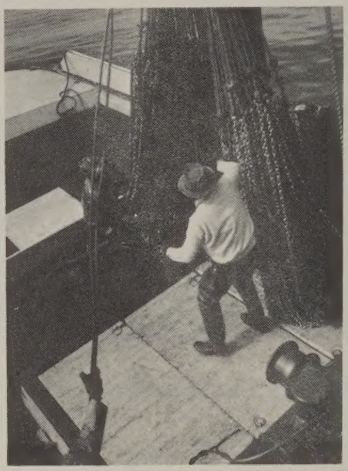
The fork length of each fish was measured to the closest half centimeter, and age was determined from a scale taken from the lateral area between the insertion of the dorsal fin and the lateral line. Only fish in apparent excellent condition were tagged. Those that had been gilled or wounded, or dropped while handling, were released overboard without being tagged. With the possible exception of a few chum salmon and most king salmon, all tagged fish were sexually mature and

(1) Seine skiff pulling net off stern of seiner at beginning of set

(2) Skiff on parallel course with seiner to hold mouth of seine open during tow



(5) Purse rings being hauled aboard seiner



(6) Heavy chain lead line being pulled aboard seiner

(9) Seine skiff pulling vessel broadside into wind to prevent it from drifting over net

(10) Webbing being piled on stern by crewmen as it descends from power block

Figure 3.--Successive steps in capturing salmon

(3) Arc of net open during tow to intercept migrating fish

(4) Seine skiff pulling bunt end of net to seiner

(7) End of net being threaded through power block

(8) Net being pulled aboard seiner by power block

(11) Fish being dipped from bunt end of seine to live tank. Standoff poles keep seine skiff away from seiner

(12) Eight-thousand-gallon circulating sea-water tank for holding live salmon before tagging

for tagging with purse seiner, California Rose.

were not so susceptible to tagging injury as immature salmon.

To determine whether a full-twist knot in the pointed end of the tagging pins would result in less loss of tags than a half-twist knot, one tagging crew used a half-twist knot and one a full-twist (fig. 4). The additional time required to make the full-twist knot averaged about 2 seconds.

To publicize the tagging program to the fishermen, each tag returned was exchanged for a silver dollar. Silver dollars attract attention because very few are in circulation in the areas where tags were expected to be recovered.

The general tagging locality was from Deer Island off the southwestern shore of the Alaska Peninsula to Cape Lutke on Unimak Island (fig. 1). We spent most effort in capturing fish in the area between Cape Pankof and Cape Lutke, and tagged most fish in the vicinity of Cape Lutke between June 15 and 25. A few salmon were tagged along the mainland shore from Ikatan Bay to Deer Island between July 8 and 14. The fishing locations and the numbers of salmon tagged are listed in table 1.

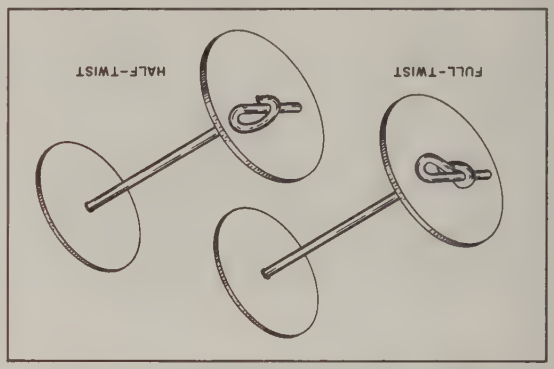


Figure 4.--Tagging pins showing half- and full-twist knot used in experiments to test tag loss.

Table 1.--Fishing locations and numbers of salmon tagged in experiments off south shore of Unimak Island and southwestern shore of Alaska Peninsula, 1961

Date	Fishing location			Tow		Salmon tagged				
	Latitude north	Longitude west	Vicinity	Direction net open	Time	Sockeye	Chum	Pink	King	Coho
					Min.	No.	No.	No.	No.	No.
June										
15	54°36'	163°12'	Cape Pankof	ESE	30	24	14	10	1	
15	54°34'	163°38'	Cape Lazaref	ESE	30	1	12	2		
15	54°32'	164°07'	Unimak Bight	E	40		2			
16	54°28'	163°37'	Cape Lazaref	E	40	2	7			
16	54°26'	164°17'	Cape Lutke	NE	40	25	81	3		
17	54°28'	164°14'	Cape Lutke	NE	50	12	11	2		
17	54°27'	164°17	Cape Lutke	NE	50	91	59	6		
17	54°26'	164°20	Cape Lutke	NE	35	1	4	3		
19	54°34'	164°00'	Unimak Bight	NE	35	26		4		
19	54°34'	164°09'	Unimak Bight	NE	35	113	31	7		
19	54°29	164°16'	Cape Lutke	NE	40	316	83	12		
20	54°31	164°13'	Cape Lutke	NE	40	52	46	8		
20	54°29'	164°18'	Cape Lutke	NE	50	320	346	17		
21	54°12'	163°55'	Unimak Pass	E	45	2	2			
21	54°36'	163°19'	Cape Pankof	E	35	10	2	2		
22	54°33'	163°09'	Cape Pankof	ESE	45	1		2		
22	54°37'	163°03'	Cape Pankof	NE	35	50	44	14		
23	54°38'	163°03'	Cape Pankof	NE	40	23	37	10		
24	54°31'	164°16'	Cape Lutke	NE	30	23	22	4	1	
24	54°26'	164°18'	Cape Lutke	NE	45	15	19	8		
25	54°24'	164°21'	Cape Lutke	NE	40		3	1		
25	54°26'	164°18'	Cape Lutke	NE	35	11	7	6		
25	54°00'	164°14'	Cape Lutke	NE	40		1	1		
26	54°40'	162°56'	Cape Pankof	E	40	4	6	2		
26	54°39'	163°03'	Cape Pankof	NE	40	50	22	14		
26	54°44'	162°59'	Cape Pankof	E	35	11	1	2		
28	54°57'	162°09'	Deer Island	SE	55	6	3	1		
28	54°49'	162°17'	Deer Island	E	30		1			
28	54°55'	162°10'	Deer Island	ESE	40	19	3	4		

Table 1.--Fishing locations and numbers of salmon tagged in experiments off south shore of Unimak Island and southwestern shore of Alaska Peninsula, 1961--Continued

Date	Fishing location			Tow		Salmon tagged				
	Latitude north	Longitude west	Vicinity	Direction net open	Time	Sockeye	Chum	Pink	King	Coho
					Min.	No.	No.	No.	No.	No.
July										
2	54°44'	163°02'	Cape Pankof	NE	45	11	6	7		
4	54°29'	164°16'	Cape Lutke	NNE	35	4	7	3		2
4	54°45'	163°00'	Cape Pankof	NE	45	3	8	2		
8	54°54'	163°03'	Morzhovoi Bay	S	40		1			
8	54°51'	163°08'	Ikatan Bay	N	45		1	7	2	
8	54°46'	163°15'	Ikatan Bay	NNE	45	5	6	7		1
8	54°46'	163°13'	Ikatan Bay	NNE	50	6	5	4	1	
9	54°38'	163°05'	Cape Pankof	NE	50	17	10	12	1	
9	54°38'	163°06'	Cape Pankof	NE	40	4	5	8	1	
9	54°43'	163°02'	Cape Pankof	NE	25	11	7	4		
10	54°48'	162°18'	Deer Island	NNE	45	12	11	7		
10	54°51'	162°13'	Deer Island	NE	55	4	5	2		
10	54°58'	162°10'	Deer Island	E	35	7	3	6		
10	55°00'	162°15'	Deer Island	ENE	40	3	6	6	2	
11	55°01'	162°22'	Deer Island	ENE	40	1		3		
11	55°02'	162°31'	Deer Island	S	35		3			
11	55°17'	162°37'	Cold Bay	SE	35	1				
12	55°09'	162°30'	Cold Bay	S	40		1	4		
12	55°01'	162°20'	Deer Island	E	40	2	11	1	1	
12	55°01'	162°18'	Deer Island	SE	35	3	10	2		
13	54°56'	163°00'	Morzhovoi Bay	SW	30	1	3	2		
13	54°50'	163°11'	Ikatan Bay	ENE	30	6	11	1	4	
13	54°48'	163°13'	Ikatan Bay	ENE	25	1	3	4	3	1
14	54°59'	162°58'	Morzhovoi Bay	SE	30	8	4	10	3	
Total						1,318	996	247	20	4

RESULTS

Recovery percentages of tagged salmon were low; the maximum was 6.4 percent for sockeye. An important factor in interpreting the tag recoveries was the extreme variation in recovery efforts in respect to both time and place. It is possible that large numbers of tagged fish migrated to uninhabited or unfished spawning tributaries of the Bering Sea. In Bristol Bay the fishing season for sockeye salmon was closed during the last part of the summer to permit adequate spawning escapement, thereby eliminating many potential tag recoveries in the area.

On the other hand, it is probable that nearly all of the tagged fish captured in the commercial fishery in the tagging area were reported. The California Rose, which fished among the commercial fleet, was plainly marked as a research vessel. Bureau employees, responsible for tag recoveries on the fishing grounds, were aboard cannery tenders operating out of False Pass and King Cove.

The advantage of using silver dollars to pay for tags could not be evaluated, but the innovation did attract the attention of fishermen and reminded them of the program whenever they encountered a silver dollar during business transactions.

Full-twist Versus Half-twist Knots for Tags

The experiment to test the full-twist versus the half-twist knot was made during part of the cruise (June 15-28) while two tagging crews were aboard. One crew tied pin knots with the half-twist exclusively, while the other used the full-twist. The numbers of fish tagged using each knot during this period and the number of recoveries are given in table 2. A higher recovery from salmon tagged with the half-twist knot was obtained (6 percent versus 4.6 percent). With pooled data we used a chi-square analysis to test the hypothesis of equal recovery for both types of knots. No significant difference between the recovery rates of salmon tagged with the two types of knots can be demonstrated:

$$(X^2 = 1.85, \text{d.f.} \quad 1, P = 0.18).$$

Table 2.--Comparison of recoveries of salmon tagged with pins tied in half-twist knot with those tied with full-twist knot. (June 15-28, 1961)

Species of salmon	Half-twist knot		Full-twist knot	
	Tagged	Recovered	Tagged	Recovered
	Number	Number	Number	Number
Sockeye.	697	42	511	28
Chum	453	30	416	17
Pink	84	2	61	1
King	0		2	0
Total	1,234	74	990	46

Sockeye Salmon

Most of the sockeye salmon were tagged from June 15 to July 9. Of the 1,318 sockeye salmon tagged, 84 (6.4 percent) were recovered (table 3).

Most returns were from the Kvichak-Naknek system (46.4 percent of the number recaptured)[2] and the Egegik system (15.5 percent) (fig. 5). At Cape Lutke, 18 tagged sockeye salmon (21.4 percent of those recaptured) were recovered but only 3 of these had been tagged there. The other 15 tagged fish recovered at Cape Lutke had been tagged at points to the east--4 from Unimak Bight (10 miles) and 11 from Cape Pankof (45 miles); elapsed time between tagging and recapture averaged only 1 day. The small number of recoveries of sockeye salmon tagged at Cape Lutke and later recovered in the same place and the short time between release of tagged fish at Cape Pankof and recapture at Cape Lutke indicate a rapid westerly movement along the south shore of Unimak Island. From the similarity in distribution of recoveries between the 1961 and the 1922 and 1923 taggings (Gilbert, 1923; Gilbert and Rich, 1925), we infer that the Cape Lutke fishery does intercept the westerly migration previously demonstrated.

The recapture of tagged sockeye salmon indicates only a negligible easterly migration

[2] An additional tag from a sockeye salmon tagged at Cape Pankof on July 9, 1961, was found on the beach of Iliamna Lake in summer 1963.

Table 3.--Distribution of recaptured sockeye salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula, June 15 to July 14, 1961

Tagging location	Inclusive tagging dates	Fish tagged	Tags recovered in--											Total recovered	
			Bristol Bay			North Alaska Peninsula		South Alaska Peninsula				Chignik Lagoon	Kodiak Island (Red River)		
			Togiak Bay	Kvichak-Naknek Rivers	Egegik River	Cape Seniavin	Izembek Bay	Cape Lutke	East Anchor Cove	Cold Bay	Fox Bay				
		No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Percent
Unimak Pass	June 21	2												0	
Cape Lutke	June 16-July 4	870		20	6		1	3	1					31	3.6
Unimak Bight	June 15-19	139		5	2			4						11	7.9
Cape Lazaref	June 15-16	3												0	
Cape Pankof	June 15-July 9	219		13	3	1		11	2				1	31	14.2
Ikatan Bay	July 8-13	18	1		2						1			4	22.2
Morzhovoi Bay	July 13-14	9								2				2	22.2
Cold Bay	July 11	1								1				1	
Deer Island	June 28-July 12	57		1						1		2		4	7.0
Total		1,318	1	39	13	1	1	18	3	4	1	2	1	84	6.4
Percent of recoveries			1.2	46.4	15.5	1.2	1.2	21.4	3.6	4.8	1.2	2.4	1.2		

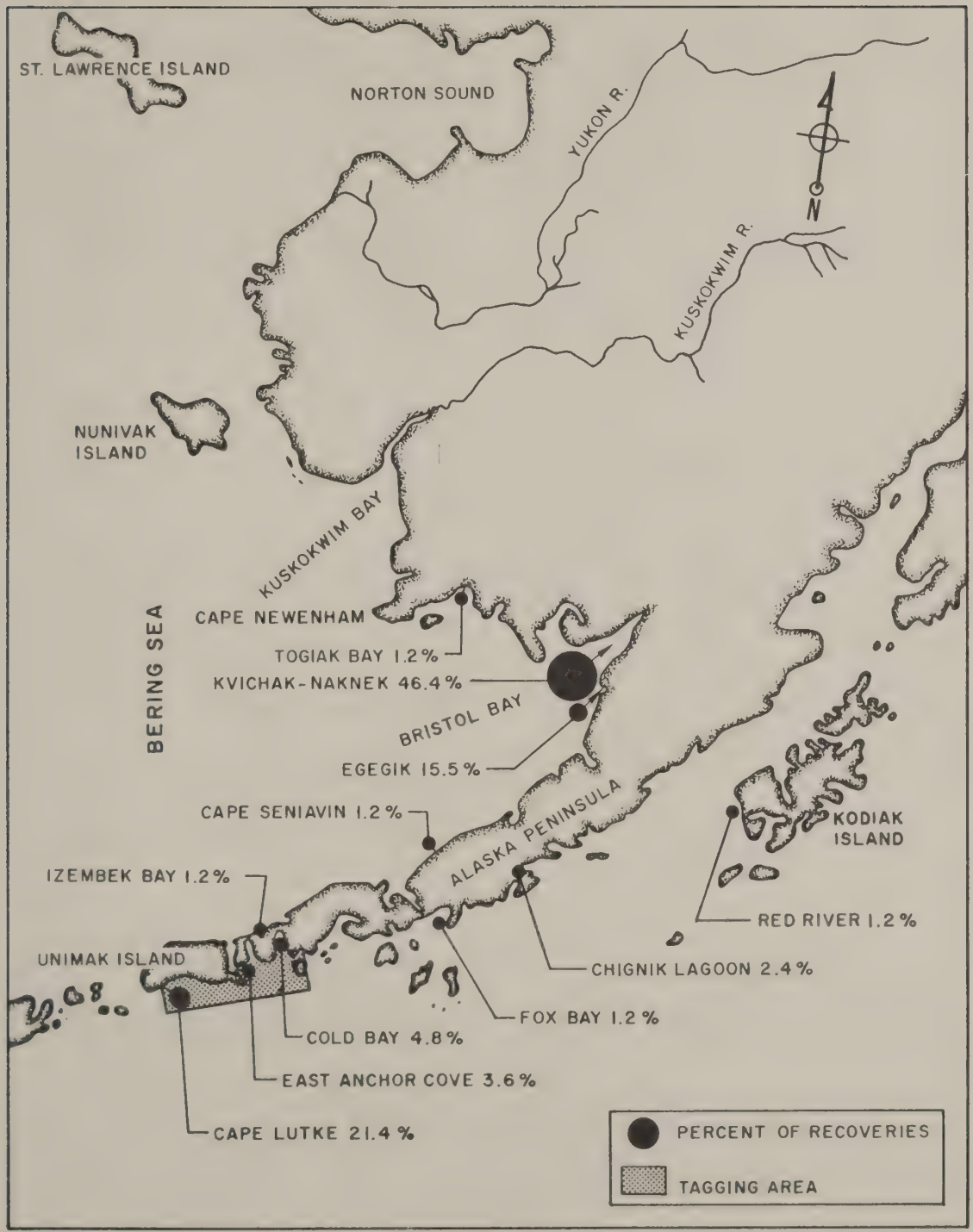


Figure 5.--Distribution of recaptured sockeye salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula, June 15 to July 14, 1961.

of sockeye salmon from the area between Cape Lutke and Cape Pankof. One sockeye salmon tagged at Cape Lutke and two tagged at Cape Pankof were taken in East Anchor Cove on the southeastern shore of the Ikatan Peninsula near Cape Pankof (fig. 5). Another sockeye salmon tagged on June 26 at Cape Pankof was recaptured at Red River, Kodiak Island, on July 5. These few recoveries of tags to the east of the tagging area, when considered with the preponderance of Bristol Bay recoveries, confirm that the Cape Lutke fishery is the last point at which the westward migration is intercepted south of the Bering Sea.

Between June 17 and 25, 1961, the Alaska Department of Fish and Game tagged 130 sockeye salmon in Stepovak Bay approximately 200 miles northeast of our tagging area.[3] Thirteen recaptures were made, three near the Stepovak Bay tagging site and the rest at points east of the tagging site--eight at Chignik, one at Karluk, and one at Cook Inlet. In addition, six tagged fish were observed passing through the Chignik weir. Thus, simultaneous tagging in June by us and by State personnel at sites 150 miles apart demonstrated migration of sockeye salmon in opposite directions.

An average rate of travel calculated for 44 fish (the number for which complete return information was reported) recaptured at Kvichak and Egegik was 31.3 miles per day, with a standard deviation of 6.2. This agrees closely with an average rate of travel of 31 ±6.6 miles per day reported by Hartt (1962) for sockeye salmon traveling from the Pribilof Islands to Bristol Bay in 1958. Elapsed time between tagging and recapture of the 44 fish was 11-20 days, with a mean of 14.9 days.

As determined from scales, more than 70 percent of the salmon tagged were 5-year-olds (table 4).

Table 4.--Age of sockeye salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula, June 15 to July 14, 1961

Age group	Sockeye salmon tagged	
	Number	Percent
21	1	0.08
41	5	0.4
42	89	6.8
43	1	0.08
52	418	31.7
53	522	39.6
63	49	3.7
64	1	0.08
Scale illegible or regenerate	232	17.6
Total	1,318	

Chum Salmon

Of the 996 chum salmon tagged, 60 (6.0 percent) were recovered (table 5). The recaptures were reported from 25 locations, the majority being made at points along the north side of the Alaska Peninsula, in Bristol Bay, and at various rivers along the Bering Sea coast (fig. 6).

Chum salmon exhibited the same general migration patterns as sockeye, but with a broader area of dispersion. Fish tagged in June along Unimak Island traveled into the Bering Sea and displayed little tendency to move eastward to points along the south side of the Alaska Peninsula. Chum salmon tagged early in July were a mixture of both local and migratory runs. Of 127 fish tagged in July, 11 were recaptured--8 from nearby bays on the south side of the Alaska Peninsula, and 1 each from Nelson Lagoon on the north side of the Peninsula; Paramanof Bay, Kodiak Island; and the Shinkushiro River, Hokkaido, Japan. The Japanese recovery, made November 9, 1961, was a 4-year-old chum salmon tagged on July 8 in Ikatan Bay. We know of only one other chum salmon tagged within North American waters and recovered in Asia--one tagged at Coal Harbor, Unga Island, on July 4, 1923, and recovered in the Pankara River, Kamchatka (Gilbert and Rich, 1925). Gilbert and Rich also reported that chum salmon tagged on July 4 and 6 at Unga Island were recaptured in Bristol Bay and the Yukon River.

The average rates of travel for chum salmon have not been calculated, but elapsed and mean times between tagging and recapture are given in table 6. Evidently chum salmon either travel at a slower rate than sockeye or take a less direct route to spawning destinations. The mean number of days out for 44 sockeye salmon between tagging and recapture in the Kvichak and Egegik area was only 14.9 days; for 5 chum salmon recovered in the same district, the mean lapse was 21 days.

Nearly 70 percent of the tagged chum salmon were 4-year-olds (table 7).

Pink Salmon

Thirteen (5.3 percent) of the 247 pink salmon tagged were recaptured (table 8). Recovery locations indicate that pink salmon

[3] Personal communication, Daniel P. Hennick, Alaska Department of Fish and Game, April 27, 1962.

Table 5.--Distribution of recaptured chum salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula, June 15 to July 14, 1961

Tagging location	Inclusive tagging dates	Fish tagged	Tags recovered in--																										Total recovered	
			Bering Sea Coast				Bristol Bay					North Alaska Peninsula						South Alaska Peninsula								Kodiak I.	Japan			
			Koyuk River	Yukon River	Kuskokwim River	Goodnews Bay	Togiak Bay	Nushagak Bay	Kvichak-Naknek Rivers	Egegik River	Ugashik River	Port Heiden	Bear River	Nelson Lagoon	Moffet Bay	Izembek Bay	St. Catherine Cove	Cape Lutke	East Anchor Cove	Morzhovoi Bay	Cold Bay	Belkofski Bay	Canoe Bay	Balboa Bay	Area unknown	Paramanof Bay	Shinkuehiro River		
		No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Percent
Unimak Pass	June 21	2																										0	
Cape Lutke	June 16-July 4	689		4	3	1	6	7	3		1		1		1		1	2										30	4.4
Unimak Bight	June 19	33		1	1													3										5	15.2
Cape Lazaref	June 15-16	19		1						2																		4	21.1
Cape Pankof	June 16-July 4	162	1	3	1							1						1	1	1					1			10	6.2
Ikatan Bay	July 8-13	26																					1			1	1	3	11.5
Morzhovoi Bay	July 8-14	8																		1	1							2	25.0
Cold Bay	July 12	1																										0	
Deer Island	June 28-July 12	56						1						1							1	1	1	1				6	10.7
Total		996	1	9	5	1	6	8	3	2	1	1	1	1	1	1	1	6	1	2	2	1	2	1	1	1	1	60	6.0
Percent of recoveries			1.7	15.0	8.3	1.7	10.0	13.3	5.0	3.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	10.0	1.7	3.3	3.3	1.7	3.3	1.7	1.7	1.7	1.7		

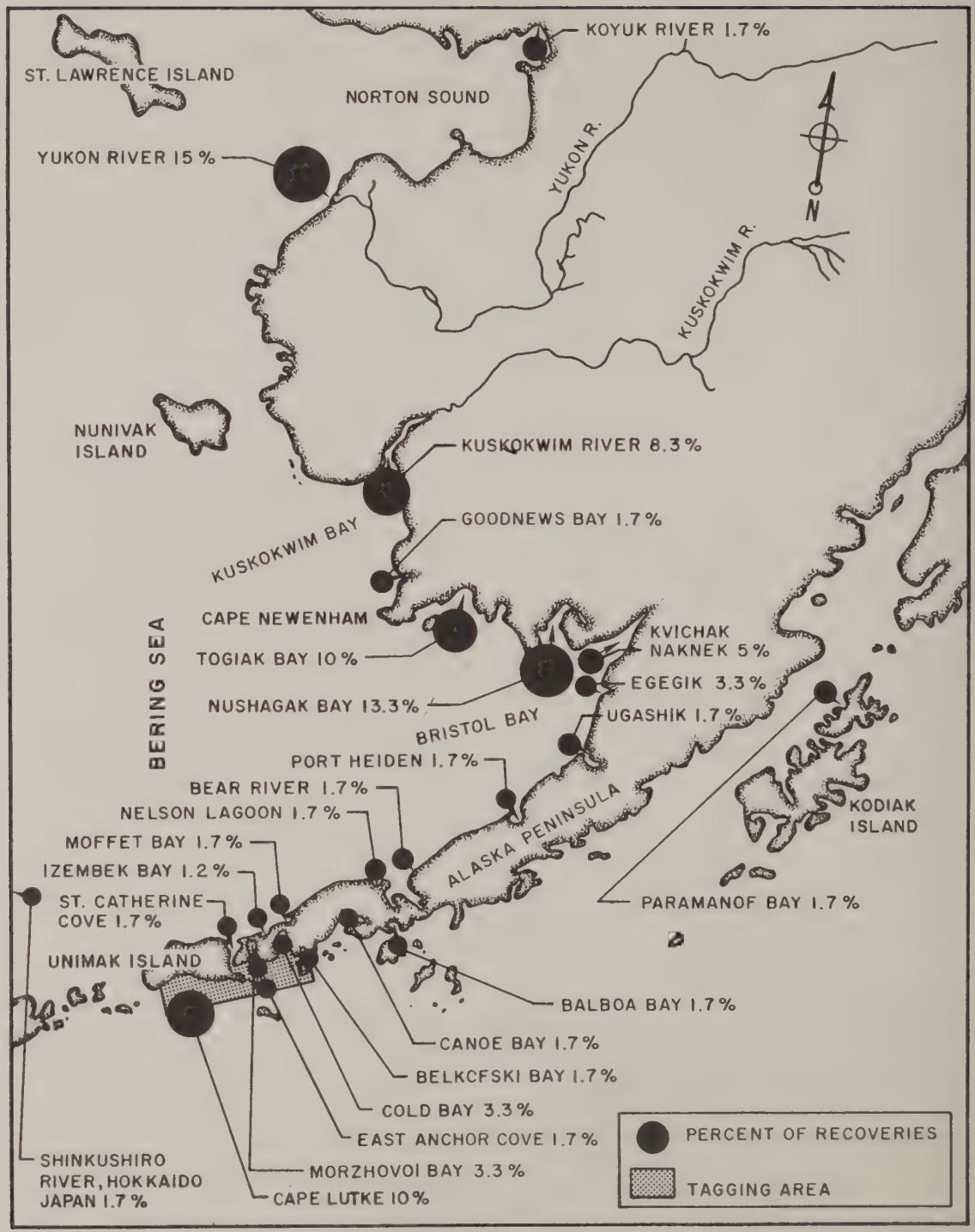


Figure 6.--Distribution of recaptured chum salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula, June 15 to July 14, 1961.

Table 6.--Elapsed time between tagging of chum salmon off south shore of Unimak Island and southwestern shore of Alaska Peninsula and recapture at principal recovery areas, 1961

Area of recapture	Chum salmon recaptured	Elapsed time	
		Range	Mean
	Number	Days	Days
Yukon River	6	17-38	23.2
Kuskokwim River	5	15-32	26.0
Togiak Bay	6	11-34	18.5
Nushagak Bay	7	13-33	22.6
Kvichak and Egegik	5	13-31	21.0

Table 7.--Age of chum salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula, June 15 to July 14, 1961

Age	Chum salmon tagged	
	Number	Percent
2	1	0.1
3	40	4.0
4	684	68.7
5	167	16.8
Scale illegible or regenerate	104	10.4
Total	996	

from widely separate spawning grounds were passing through the tagging area (fig. 7).

During June 15-28 inclusive, 145 Pink salmon were tagged; only 4 were recaptured. The recaptured fish were taken at points west of the tagging sites--two at Cape Lutke (tagged at Unimak Bight and Cape Pankof); one at Ikatan Bay (tagged near Deer Island); and one near Pakachak River, East Kamchatka, U.S.S.R. (tagged in Unimak Bight).

Although most pink salmon tagged during July were recaptured near the tagging sites, two migrated in an easterly direction. One was tagged July 8 at Cape Pankof and recaptured in the Buskin River, Kodiak Island, and the other was tagged July 14 in Morzhovoi Bay and recaptured in Geographic Harbor on the Alaska Peninsula north of Kodiak Island.

Too few pink salmon were tagged and recovered to warrant any conclusions, but the pattern of recoveries was similar to 1958 when pink salmon tagged in June migrated west, and those tagged in July spawned in local streams (Thorsteinson, 1959).

Coho and King Salmon

Not one of the 4 coho or 20 king salmon tagged was recaptured. Eighteen of the king salmon were immature and had lengths of 350-575 mm. All immature king salmon had spent only one winter at sea, and most were tagged near Cape Pankof in early July.

SUMMARY

Salmon tagging off the south shore of Unimak Island and the southwestern shore of the Alaska Peninsula from mid-June to mid-July of 1961 demonstrated that sockeye and chum salmon move westerly and then northeasterly into the Bering Sea. Lack of movement eastward from Cape Lutke indicates that this is the last point at which salmon migrating into the Bering Sea are taken south of the Peninsula.

Of 1,318 sockeye salmon tagged, 84 (6.4 percent) were recaptured; 63 percent of the number recaptured were taken in Bristol Bay. The average rate of travel from the tagging area to the Kvichak-Naknek and Egegik areas was 31.3 $\mp$ 6.2 miles per day; elapsed time between tagging and recapture was 11-20 days, with a mean of 14.9. More than 70 percent of the tagged sockeye salmon were 5-year-olds.

Of 996 chum salmon tagged, 60(6.0 percent) were recaptured. Chum salmon exhibited a broad pattern of dispersion, with most recaptures being made from points along the north side of the Alaska Peninsula, Bristol Bay, and the Bering Sea coast as far north as the Koyuk River on Norton Sound. One tagged chum salmon was recovered from a Japanese river and another from Kodiak Island. Nearly 70 percent of the tagged chum salmon were 4-year-olds.

Of 247 pink salmon tagged, 13 (5.3 percent) were recaptured. Too few pink salmon were tagged and recovered to warrant definite conclusions, but the results indicate an intermingling of widely separated stocks as evidenced by one recapture from Kodiak Island and another in the Pakachak River, Kamchatka, U.S.S.R.

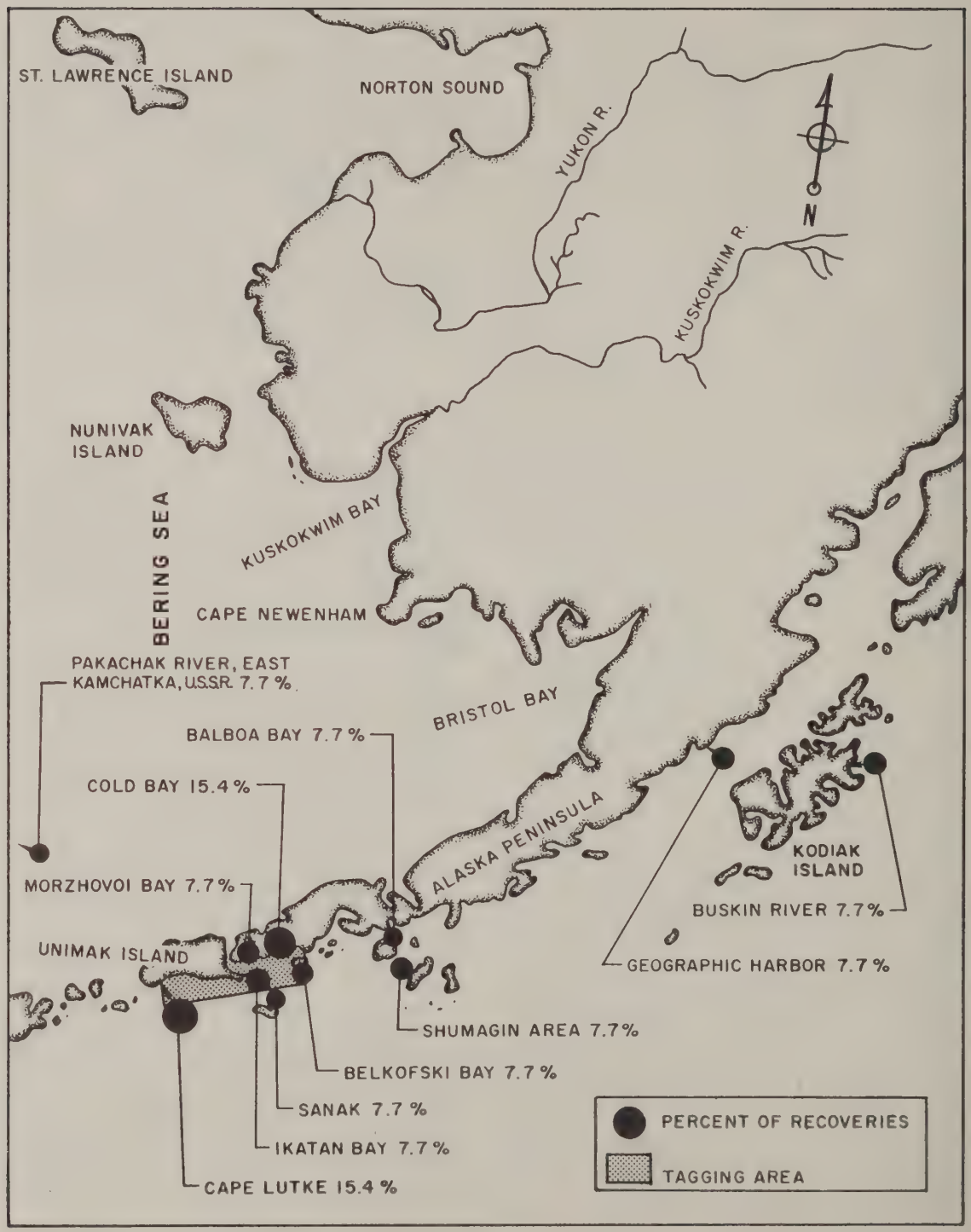


Figure 7.--Distribution of recaptured pink salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula, June 15 to July 14, 1961.

Table 8.--Distribution of recaptured pink salmon tagged off south shore of Unimak Island and southwestern shore of Alaska Peninsula June 15 to July 14, 1961

Tagging location	Inclusive tagging dates	Fish tagged	Tags recovered in--											Total recovered	
			USSR	South Alaska Peninsula									Kodiak		
			Pakachak River	Cape Lutke	Ikatan Bay	Sanak Harbor	Morzhovoi Bay	Cold Bay	Belkofski Bay	Balboa Bay	Shumagin Area	Geographic Harbor	Buskin River		
		No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Percent
Cape Lutke	June 16-July 4	74												0	
Unimak Bight	June 19	11	1	1										2	18.2
Cape Lazaref	June 15	2												0	
Cape Pankof	June 15-July 9	89		1									1	2	2.2
Ikatan Bay	July 8-13	23					1				1			2	9.1
Morzhovoi Bay	July 13-14	12						2				1		3	25.0
Cold Bay	July 12	4												0	
Deer Island	June 28-July 12	32			1	1			1	1				4	12.5
Total		247	1	2	1	1	1	2	1	1	1	1	1	13	5.3
Percent of recoveries		5.3	7.7	15.4	7.7	7.7	7.7	15.4	7.7	7.7	7.7	7.7	7.7		

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